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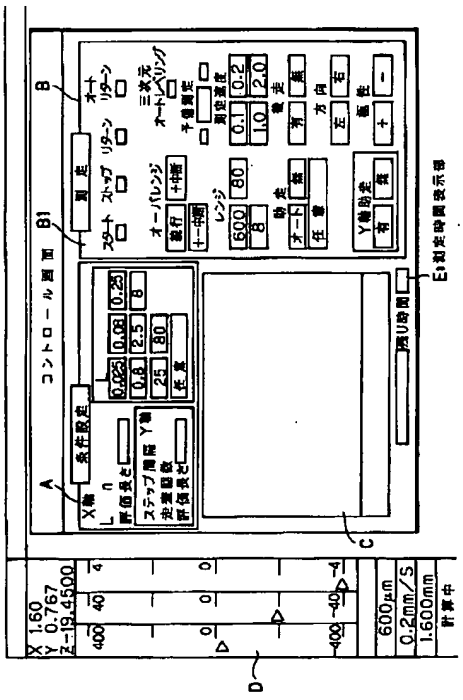
(71)出願人　000137694
株式会社ミツトヨ
東京都港区芝５丁目31番19号
(72)発明者　片山　実
神奈川県川崎市高津区坂戸165番地　株式会社ミツトヨ開発研究所内
(74)代理人　弁理士　伊丹　勝

(54)【発明の名称】　測定機

(57)【要約】
【目的】　測定機における所要測定時間を測定条件から計算して表示し、測定作業の効率を向上させる。
【構成】　測定機における所要測定時間を与えられた測定条件から計算し、測定進行と共に減少する残り測定時間を表示装置に表示する。３次元モード測定機では、トラバース長さｔｒａｖ、走査回数ｍ、ステップ間隔ｓｔｅｐ、測定速度Ｓ１、リターン速度Ｓ２、Ｙ軸駆動速度ＳＹを与えると、以下の式で残り測定時間ｔを順次算出して表示する。但し、ｍ１は走査済み回数（ｍ１＝０～ｍ－１）、ｋは内部処理時間である。
ｔ＝（ｔｒａｖ／Ｓ１＋ｔｒａｖ／Ｓ２＋ｋ）×（ｍ－ｍ１）＋（ｓｔｅｐ／ＳＹ）×（ｍ－ｍ１－１）
【効果】　測定に必要な時間を非熟練者でも容易に且つ正確に判別でき、測定完了までの時間を他の用途に有効に活用できる。



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【特許請求の範囲】

【請求項1】　所要測定時間を与えられた測定条件から計算し、測定進行と共に減少する残り測定時間を表示装置に表示することを特徴とする測定機。

【請求項2】　トラバース長さｔｒａｖ、走査回数ｍ、＊

$$t=(trav/S1+trav/S2+k)\times(m-m1)+(step/SY)\times(m-m1-1)$$

但し、ｍ１は走査済み回数（ｍ１＝０～ｍ－１）、ｋは内部処理時間である。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、測定に必要な時間を表示する測定機に関する。

【０００２】

【従来の技術】物体表面の性状は、変化の小さい順に、粗さ、うねり、輪郭（形状）等と呼ばれる。表面性状測定機は、この様な物体表面の性状を、接触型または非接触型の検出器を用いて高精度に検出する。図４はこの様な表面性状測定機の機構部分を示す構成図で、２１は検出器、２４は検出器送りユニットである。この送りユニット２４はコラム機構２５によって上下動（Ｚ軸方向）可能であり、これにより測定物（ワーク）３０とのＺ軸方向の距離を任意に調整できる。ワーク３０はオートレベリングテーブル２６上に載置され、所定の範囲内で任意に水平度（角度θ）を調整できる。３１はテーブル２６や送りユニット２４等を安定した位置関係に保つ定盤である。

【０００３】この検出器２１を送りユニット２４によって水平（Ｘ軸）方向に移動させながらワーク３０の表面をなぞる、即ち走査すると、その表面の凹凸に応じて検出器２１がＺ軸方向に上下する。表面性状測定機はこの検出器２１の上下動を電気信号に変換する等してワーク表面の性状を検出し、それをＸ－Ｚ平面に表示または記録するものである。

【０００４】この検出器２１による物体表面の走査を複数回、走査方向（Ｘ軸方向）と直交する方向（Ｙ軸方向）にステップしながら行うのが３次元モード測定機である。図５は３次元モード測定機の測定方法を示している。図中、３０はワークであり、その表面を１回の走査でＸ軸方向に長さｔｒａｖだけ走査する。これがトラバース長さである。この走査をＹ軸方向にステップ間隔ｓｔｅｐだけずらしながらｍ回繰り返し行うと、ワーク３０表面の性状を３次元的に測定することができる。この※

$$t=(trav/S1+trav/S2+k)\times(m-m1)+(step/SY)\times(m-m1-1)$$

但し、ｍ１は走査済み回数（ｍ１＝０～ｍ－１）、ｋは内部処理時間である。

【０００９】

【作用】測定機における測定時間は測定条件によって異なるが、測定機内部には測定時間を求めるために必要な★

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＊ステップ間隔ｓｔｅｐ、測定速度Ｓ１、リターン速度Ｓ２、Ｙ軸駆動速度ＳＹを測定条件とし、以下の式で残り測定時間ｔを順次算出して表示することを特徴とする３次元モード測定機。

※場合の記録または表示はＸ－Ｙ－Ｚ空間で３次元的に行われる。

【０００５】

【発明が解決しようとする課題】上述したように、何回も走査を繰り返す３次元モード測定機では、１回の測定に数１０分程度要することは希ではない。この場合、使用者はいつ測定が完了するかを知らなければ、その間に定期的に測定の進行状況を確かめたり、経験によって測定時間を判断したりしなければならない。しかしながら、定期的に測定の進行状況を確認する方法は、測定者が測定完了までの待ち時間を他の用途に効率良く活用することを妨げる。一方、経験による測定時間の推測は非熟練者にとっては困難であり、また熟練者といえども多くの測定についてそれぞれの測定時間を覚えることは簡単ではない。この点を改善すべく、測定が何％終了したかを表示する測定機もある。しかしながら、この％表示では残り何分で測定が全て完了するかを判断することはできない。

【０００６】本発明はこの様な点を改善し、測定完了までの時間を与えられた測定条件から自動的に算出して表示することにより、非熟練者でも容易に且つ正確に測定時間を把握でき、その時間を他の用途に活用できるようにすることを目的としている。この測定時間は測定進行と共に減少し、従って測定時間の表示は残り時間表示となる。

【０００７】

【課題を解決するための手段】上記目的を達成するため、本発明では、所要測定時間を与えられた測定条件から計算し、測定進行と共に減少する残り測定時間を表示装置に表示することを第１の特徴としている。

【０００８】また、本発明では、トラバース長さｔｒａｖ、走査回数ｍ、ステップ間隔ｓｔｅｐ、測定速度Ｓ１、リターン速度Ｓ２、Ｙ軸駆動速度ＳＹを測定条件とし、以下の式で残り測定時間ｔを順次算出して表示することを第２の特徴としている。

★情報（移動量、測定速度、処理時間等）は全て揃っている。従って、この情報をもとに測定に必要な時間を計算することができ、この測定時間を表示すれば、測定者は容易に且つ正確に測定完了時点を把握することができる。これにより、熟練者でなくとも有効に時間を活用す

ることができ、測定作業の効率を向上させることができる。

【0010】

【実施例】以下、図面を参照して本発明の実施例を説明する。図1は本発明の一実施例を示す表面形状測定機の部分正面図で、3次元モードでの測定を可能とする測定条件の設定部A、各種の測定に必要な操作を行う操作部B、測定結果の表面性状データ（拡大記録図形）を表示する表面性状表示部C、検出器21の現在位置を異なるレンジ（倍率）で同時に表示する検出器ポジション表示部D等を備えたコントロール画面を示している。このコントロール画面に、測定完了までの残り時間を自動的に表示する測定時間表示部Eを設けたのが本例の特徴である。

【0011】条件設定部Aには、X軸に関しては、基準長さLと、このLを何区間使用するかを示す区間数nの各設定部があり、またLとnの設定により自動的に決まるX軸評価長さの表示部がある。一方、Y軸に関しては、ステップ間隔（ｓｔｅｐ）と、走査回数（m）の各設定部があり、またｓｔｅｐとmの設定により自動的に決まるY軸評価長さの表示部がある。Lは0．025から80までの複数の数値をワンタッチで選択できるほか、任意の数値を入力することもできる。測定操作部Bには、測定のスタート、ストップ、リターン、オートリターンの各指示スイッチがあり、またオーバレンジ、レンジ、助走、Y軸助走、予備測定、後走、方向、極性の各選択スイッチがある。レンジは拡大倍率に関するものであり、また予備測定は本測定に先立って行う調整用の測定の回数に関するものである。助走は本測定区間に先行する区間の走査であり、また後走は本測定区間に後続する区間の走査である。前述したトラバース長さｔｒａｖはL×n＋助走長さ＋後走長さで計算される。

【0012】図2は表面性状測定機の信号処理及び表示＊

＊装置の構成図である。図中、10は共通バス、11は制御中枢となるＣＰＵ（中央処理装置）、12は種々のデータを記憶するＲＡＭ（ランダムアクセスメモリ）、13は各種プログラムを格納したＲＯＭ（リードオンリーメモリ）、14は図1の画面全体を表示できるＣＲＴディスプレイ、15はそのコントローラである。本例ではＲＡＭ12に測定条件を記憶し、またＲＯＭ13に測定時間計算用のプログラムを格納してある。

【0013】図3はＣＰＵ11で実行される測定時間計算及び表示処理を概略的に示すフローチャートである。この処理は、例えば図1の画面で測定操作部Bに表示されているスタートスイッチB1を押したときにスタートし、先ずステップＳ1において、条件設定部Aで設定された測定条件を読み込んでＲＡＭ12に記憶する。次いでステップＳ2において、与えられた測定条件から測定完了までに必要な測定時間tを計算する。そして、ステップＳ3でこの時間tを図1の測定時間表示部Eに表示したら、次のステップＳ4で測定終了か否かを判定する。ここで、測定終了でないと判定されたら、ステップＳ1へ戻って同様の処理を繰り返す。

【0014】図3の測定時間計算を図5の3次元モードについて説明すると、次のようになる。即ち、前述したトラバース長さｔｒａｖ、走査回数m、ステップ間隔ｓｔｅｐの他に、トラバース長さｔｒａｖを検出器21で走査する際の測定速度Ｓ1、1回の走査終了時に検出器21を高速度で走査開始点に復帰させるリターン速度Ｓ2、走査開始点に復帰した検出器21を所定のステップ間隔ｓｔｅｐだけY軸方向にステップさせるY軸駆動速度ＳＹを測定条件に加え、下記数1で残り測定時間tを各走査終了毎に算出する。

【0015】

【数1】

$$t=(trav/S1+trav/S2+k)\times(m-m1)+(step/SY)\times(m-m1-1)$$

但し、m1は走査済み回数（m1＝0～m－1）、kは内部処理時間である。

【0016】上記数1の内部処理時間kには、測定開始前に移動させた軸が安定するまでの待ち時間、測定データをメモリに転送するまでの転送時間等、システム固有のものが含まれる。また、走査済み回数m1は、1回の走査が完了する毎に0から（m－1）に向けて1ずつ減少するものである。このため、数1の測定時間は測定開始から測定完了までの残り時間を順次減少させながら示すことになる。仮に、数1でこの走査済み回数m1を用いない（m1＝0とする）場合は、測定時間tが固定的に示されるだけであるが、これも一つの用法ではある。

【0017】

【発明の効果】以上述べたように本発明によれば、測定完了までの残り時間を与えられた測定条件から自動的に※算出して表示することにより、非熟練者でも容易に且つ正確に測定時間を把握でき、その時間を他の用途に活用することができる。また、測定に必要な時間が測定前に判明するため、無理な測定条件を設定した測定を未然に回避することができる。更に、同じ測定を行う場合は、設定の間違いを発見できる利点もある。

【図面の簡単な説明】

【図1】　本発明の一実施例を示す表示画面の構成図である。

【図2】　本発明の測定機のシステム構成図である。

【図3】　本発明の処理を示すフローチャートである。

【図4】　表面性状測定機の機構図である。

【図5】　3次元モード測定の測定原理図である。

【符号の説明】

A…条件設定部、B…測定操作部、C…表面性状表示

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部、D…検出器ポジション表示部、E…測定時間表示部、10…共通バス、11…CPU、12…RAM、13…ROM、14…CRTディスプレイ、15…CRTコントローラ、21…検出器、24…検出器送りユニット、30…ワーク。

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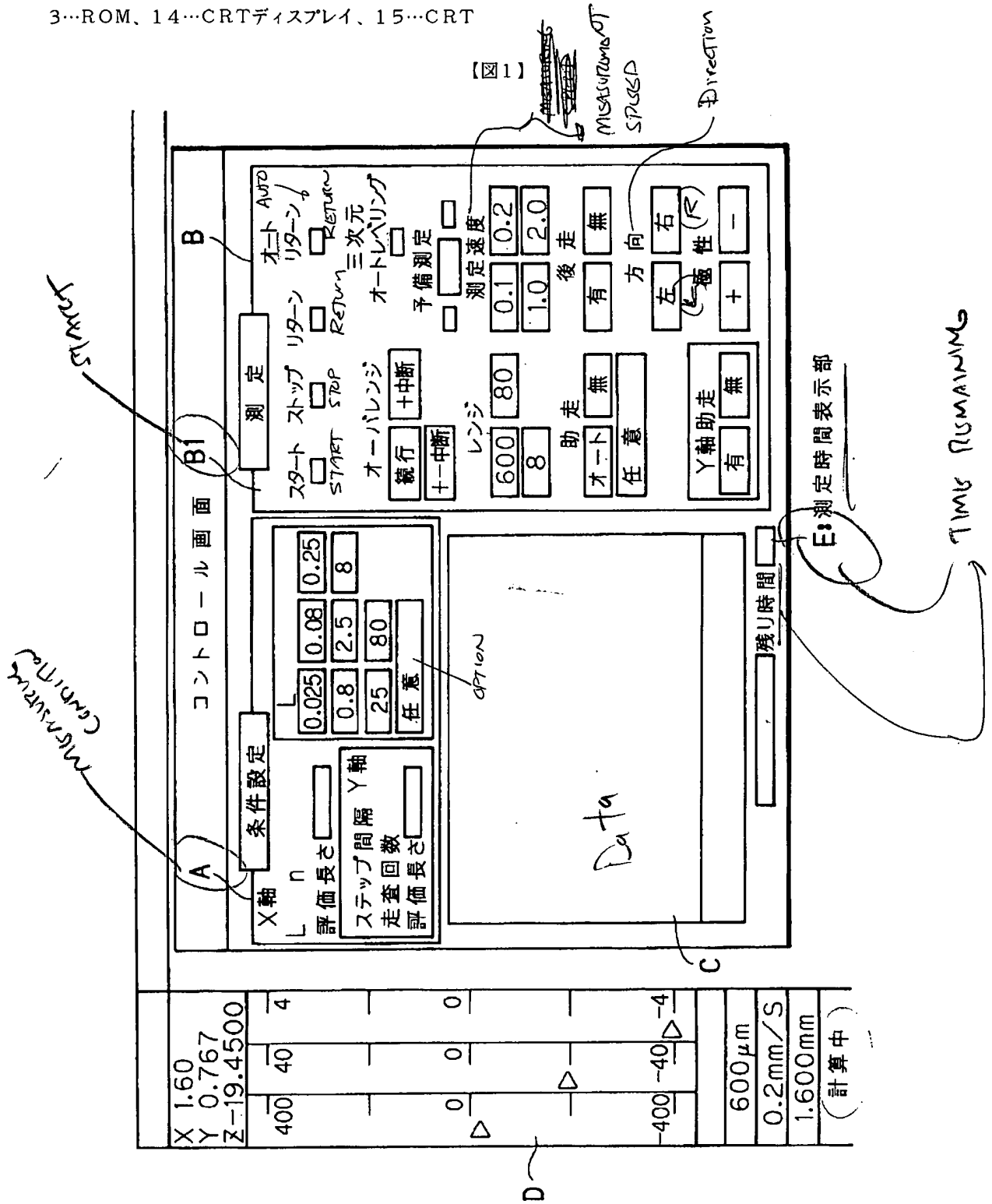
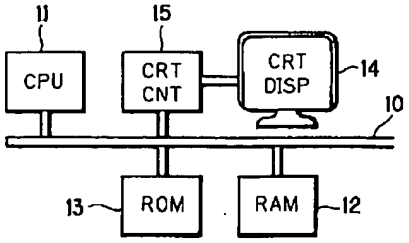
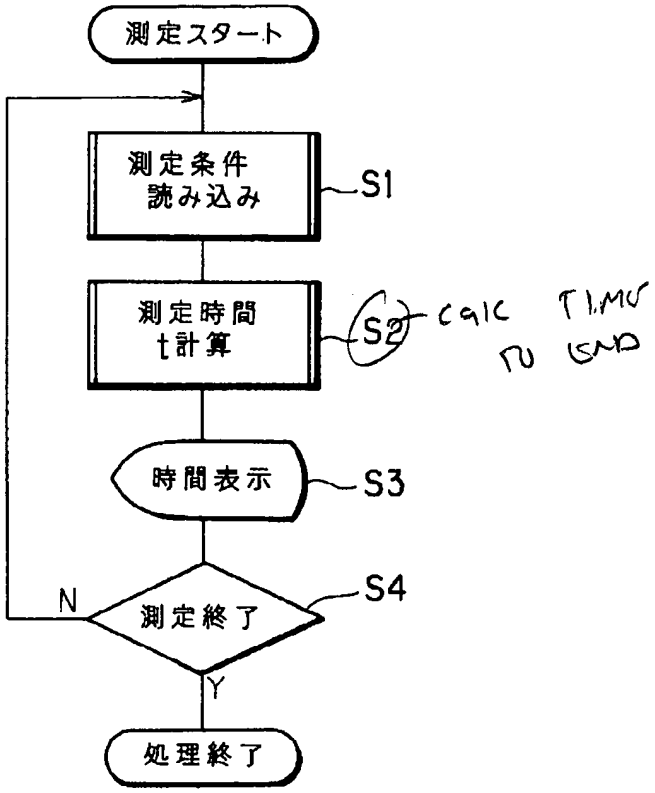
【図1】



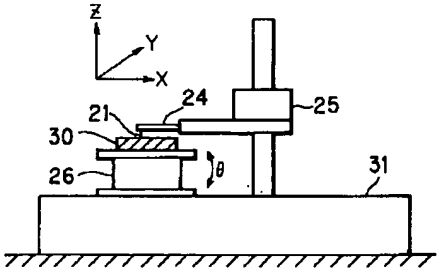
【図2】


11
15
CPU
CRT CNT
CRT DISP
14
10
13
ROM
RAM
12

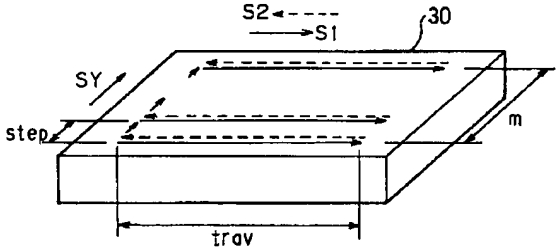
【図3】


測定スタート
測定条件読み込み
S1
測定時間t計算
S2
時間表示
S3
測定終了
S4
N
Y
処理終了

【図4】


Z
Y
X
21
24
25
30
26
θ
31

【図5】


S2
S1
30
SY
step
m
trav

PATENT ABSTRACTS OF JAPAN

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(71)Applicant : MITSUTOYO CORP

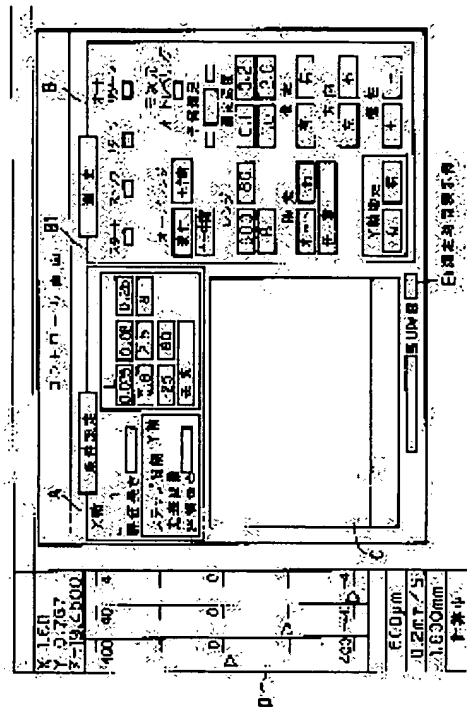
(72)Inventor : KATAYAMA MINORU

(54) MEASURING MACHINE

(57)Abstract:

PURPOSE: To display a necessary time for measurement in a measuring machine by computing it from measuring conditions and thereby to improve the efficiency of a measuring operation.

CONSTITUTION: A necessary time for measurement in a measuring machine is computed from measuring conditions being given and a residual time for measurement lessening with the progress of measurement is displayed in a display device E. When a traverse length (trav), the number (m) of times of scanning, a step interval (step), a measuring speed S1, a return speed S2 and a Y-axis drive speed SY are given, in a three-dimensional mode measuring machine, the residual time (t) for measurement is calculated sequentially by the following equation and displayed. In this equation, mark m1 denotes the number (m1 = 0 to m-1) of times of completed scanning and (k) an internal processing time. t = (trav/S1 + trav/S2 + k) x (m-m1) + (step/SY) x (m-ml-1). The time being necessary for measurement can be discriminated easily and correctly even by an unskilled person and the time till the completion of measurement can be used effectively for other purposes.



LEGAL STATUS

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[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
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PUBN-DATE: April 27, 1993

INVENTOR-INFORMATION:
NAME
KATAYAMA, MINORU

ASSIGNEE-INFORMATION:

NAME	COUNTRY
MITSUTOYO CORP	N/A

APPL-NO: JP03296649

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INT-CL (IPC): G01B021/30, G04F003/00 , G01D007/00

ABSTRACT:

PURPOSE: To display a necessary time for measurement in a measuring machine by computing it from measuring conditions and thereby to improve the efficiency of a measuring operation.

CONSTITUTION: A necessary time for measurement in a measuring machine is computed from measuring conditions being given and a residual time for measurement lessening with the progress of measurement is displayed in a display device E. When a traverse length (trav), the number (m) of times of scanning, a step interval (step), a measuring speed S1, a return speed S2 and a Y-axis drive speed SY are given, in a three-dimensional mode measuring machine, the residual time (t) for measurement is calculated sequentially by the following equation and displayed. In this equation, mark m1 denotes the number (m1 = 0 to m-1) of times of completed scanning and (k) an internal processing time. $t = (trav/S1 + trav/S2 + k) \times (m-m1) + (step/SY) \times (m-m1-1)$. The time being necessary for measurement can be discriminated easily and correctly even by an unskilled person and the time till the completion of measurement can be used effectively for other purposes.

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the measurement machine which displays time amount required for measurement.
[0002]
[Description of the Prior Art] The description on the front face of a body is called granularity, a wave, a profile (configuration), etc. to the small order of change. a front face -- description -- a measurement machine detects the description on such a front face of a body with high precision using the detector of a contact mold or a non-contact mold. such [drawing 4] a front face -- description -- it is the block diagram showing the device part of a measurement machine, and 21 is a detector and 24 is a detector delivery unit. This delivery unit 24 can move up and down according to the column device 25 (Z shaft orientations), and, thereby, can adjust the distance of Z shaft orientations with the measurement object (work piece) 30 to arbitration. A work piece 30 is laid on the auto leveling table 26, and can adjust levelness (include angle theta) to arbitration within the limits of predetermined. 31 is a surface plate which maintains a table 26 and delivery unit 24 grade at the stable physical relationship.
[0003] If the front face of a work piece 30 is traced namely, scanned, moving this detector 21 in the direction of a horizontal (X-axis) by the delivery unit 24, according to the irregularity of that front face, a detector 21 will fluctuate to Z shaft orientations. a front face -- description -- changing into an electrical signal etc. carries out vertical movement of this detector 21, and a measurement machine detects the description on the front face of a work piece, and displays or records it on a X-Z flat surface.
[0004] It is the 3D mode measurement machine which is performed carrying out the step of the scan on the front face of a body by this detector 21 in the direction (Y shaft orientations) which intersects perpendicularly with multiple times and a scanning direction (X shaft orientations). Drawing 5 shows the measuring method of a 3D mode measurement machine. Among drawing, 30 are a work piece and only die-length trav scans the front face to X shaft orientations by one scan. This is traverse die length. If it carries out repeatedly m times while only the step spacing step shifts this scan to Y shaft orientations, the description of work-piece 30 front face can be measured in three dimension. The record or the display in this case is performed in three dimension in X-Y-Z space.
[0005]
[Problem(s) to be Solved by the Invention] As mentioned above, it is not rare to require for one measurement about several 10 minutes with the 3D mode measurement machine which repeats a scan repeatedly. In this case, if a user does not know when measurement will be completed, the advance situation of measurement must be confirmed periodically [in the meantime], or he has to judge the measuring time by experience. However, the method of checking the advance situation of measurement periodically prevents an operating personnel from utilizing the latency time to the end of measurement for other applications efficiently. On the other hand, the guess of the measuring time by experience is difficult for an unskilled operator, and also although it is called an expert, it is not easy [it] to memorize each measuring time about many measurement. There is also a measurement machine which indicates

what% measurement was completed that this point should be improved. However, in this % display, it cannot judge in how many minutes it remains and all measurement is completed.
[0006] By improving such a point, computing automatically and displaying from the Measuring condition which was able to give the time amount to the end of measurement, this invention can grasp the measuring time easily and correctly also by the unskilled operator, and aims at enabling it to utilize the time amount for other applications. This measuring time will decrease with measurement advance, therefore the display of the measuring time will be a residual time display.
[0007]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, in this invention, it calculates from the Measuring condition which was able to give the necessary measuring time, and is characterized [1st] by displaying the remaining measuring time which decreases with measurement advance on a display.
[0008] Moreover, in this invention, traverse die-length trav, the count m of a scan, the step spacing step, a reading per second S1, the return rate S2, and the Y-axis drive rate SY are made into a Measuring condition, and it remains by the following formulas and is characterized [2nd] by carrying out sequential calculation and displaying the measuring time t.
t=(trav/S1+trav/S2+k) x (m-m1)
+ (step/SY)x (m-m 1-1)
However, m1 is a scanned count (m1=0-m-1), and k is internal-processing time amount.
[0009]
[Function] Although the measuring time in a measurement machine changes with Measuring conditions, all information (movement magnitude, a reading per second, processing time, etc.) required in order to find the measuring time is equal to the interior of a measurement opportunity. Therefore, if time amount required for measurement can be calculated based on this information and this measuring time is displayed, an operating personnel can grasp an end-of-measurement time easily and correctly. Thereby, even if it is not an expert, time amount can be utilized effectively and the effectiveness of measurement can be raised.
[0010]
[Example] Hereafter, the example of this invention is explained with reference to a drawing. the front face of the control unit B which performs the measurement-setup section A which drawing 1 is the partial front view of the surface-type-like measurement machine in which one example of this invention is shown, and enables measurement by 3D mode, and actuation required for various kinds of measurement, and a measurement result -- description -- the front face which displays data (an expansion record graphic form) -- description -- the control screen equipped with the detector position display D which displays the current position of a display C and a detector 21 on coincidence in a different range (a scale factor) is shown. It is the description of this example which formed the measuring-time display E which displays the residual time to the end of measurement automatically in this control screen.
[0011] There is a display of the X-axis evaluation die length which there is each setting section of the several n section which shows for what division criteria die-length L and this L are used among the conditioning sections A about the X-axis, and is automatically decided by setup of L and n. On the other hand, about a Y-axis, there is a display of the Y-axis evaluation die length which there are step spacing (step) and each setting section of the count of a scan (m), and is automatically decided by setup of step and m. L can choose two or more numeric values from 0.025 to 80 by one-touch, and also can also input the numeric value of arbitration. There is each directions switch of the start of measurement, a stop, a return, and the Ohtori turn in the measurement control unit B, and there are over range, a range, a run-up, a Y-axis run-up, preliminary measurement, back **, a direction, and each polar selecting switch in it. A range is related with the count of measurement for [which performs preliminary measurement in advance of this measurement] adjustment about magnifying power. A run-up is the scan of the section preceded with this measurement section, and back ** is the scan of the section which follows this measurement section. Traverse die-length trav mentioned above is calculated by after [Lxn+ run-up die-

length +] ****.
[0012] drawing 2 -- a front face -- description -- they are signal processing of a measurement machine, and the block diagram of a display. CPU (central processing unit) from which ten become a common bus among drawing and 11 becomes a control center, RAM (random access memory) 12 remembers various data to be, ROM (read only memory) in which 13 stored various programs, the CRT display with which 14 can display the whole screen of drawing 1 , and 15 are the controller. In this example, a Measuring condition is memorized to RAM12, and the program of measuring-time calculating is stored in ROM13.
[0013] Drawing 3 is a flow chart which shows roughly the measuring-time count and the display process which are performed by CPU11. This processing is started when the start switch B1 currently displayed on the measurement control unit B on the screen of drawing 1 is pushed, it reads first the Measuring condition set up in the conditioning section A in step S1, and memorizes it to RAM12. Subsequently, in step S2, the measuring time t required by the end of measurement is calculated from the given Measuring condition. And if this time amount t is expressed to the measuring-time display E of drawing 1 as step S3, it will judge whether it is measurement termination by the following step S4. Here, if judged with it not being measurement termination, it will return to step S1 and the same processing will be repeated.
[0014] It is as follows when measuring-time count of drawing 3 is explained about the 3D mode of drawing 5 . Namely, besides traverse die-length trav and the count m of a scan which were mentioned above, and the step spacing step Traverse die-length trav The reading per second S1 at the time of scanning with a detector 21, the return rate S2 which returns a detector 21 to a scan start point at high speed at the time of one scan termination, and the Y-axis drive rate SY which only the predetermined step spacing step makes carry out the step of the detector 21 which returned to the scan start point to Y shaft orientations are applied to a Measuring condition. It remains by the one following and the measuring time t is computed for every scan termination.
[0015]
[Equation 1]
t=(trav/S1+trav/S2+k) x (m-m1)
+ (step/SY)x (m-m 1-1)
However, m1 is a scanned count (m1=0-m-1), and k is internal-processing time amount.
[0016] The thing of system propers, such as the latency time until the shaft moved before measurement initiation is stabilized, and the transfer time until it transmits measurement data to memory, is contained in the internal-processing time amount k with one above. Moreover, the scanned count m1 decreases every [1] towards 0 to (m-1), whenever one scan is completed. For this reason, the several 1 measuring time will be shown, carrying out sequential reduction of the residual time from measurement initiation to the end of measurement. Although the measuring time t is only temporarily shown fixed when not using this scanned count m1 by several 1 (referred to as m1=0), this is also one direction for use.
[0017]
[Effect of the Invention] By according to this invention, computing automatically and displaying from the Measuring condition which was able to give the residual time to the end of measurement, as stated above, the measuring time can be grasped easily and correctly also by the unskilled operator, and the time amount can be utilized for other applications. Moreover, since it becomes clear before time amount required for measurement measuring, the measurement which set up the impossible Measuring condition is beforehand avoidable. Furthermore, when performing the same measurement, there is also an advantage which can discover the mistake of a setup.

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